MULTIMEDIA UNIVERSITY®

STUDENT ID NO

MULTIMEDIA UNIVERSITY FINAL EXAMINATION

TRIMESTER 1, 2015/2016

HBC1011 – BIOCHEMISTRY I

16th OCTOBER 2015
3:00 – 5:00 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This paper consists of **8** pages (including the front page) with **2** Parts (**A** and **B**).
2. **Part A** consists of **20** Multiple Choice Questions (MCQ). All questions carry equal marks (1 mark per question). Answer **ALL** questions in the **OMR** provided on page **6** of this paper.
3. **Part B** consists of **6** Short Answer Type questions. All questions carry equal marks (10 marks per question). Answer **FIVE (5) QUESTIONS ONLY.** Print your answers **clearly** and **neatly** in the Answer Booklet provided.
4. You may use calculator in this examination.

PART A: MULTIPLE CHOICE QUESTIONS (MCQ)
Answer ALL questions [20 marks]

1. What definition best describes the term HYDROPHOBIC?
   A. The molecular property of being unable to engage in attractive interactions with water molecules; hydrophobic substances are ionic or can engage in hydrogen bonding
   B. The molecular property of being unable to engage in attractive interactions with water molecules; hydrophobic substances are nonionic and nonpolar
   C. The molecular property of being able to engage in attractive interactions with water molecules; hydrophobic substances that are ionic or can engage in hydrogen bonding
   D. The molecular property of being able to engage in attractive interactions with water molecules; hydrophobic substances that are nonionic and nonpolar.

2. You need to prepare a buffer for use at pH 4.0. Which substance would be most effective?
   A. Lactic acid, $pK_a = 3.86$
   B. Acetic acid, $pK_a = 4.76$
   C. Phosphoric acid, $pK_{a1} = 2.14$, $pK_{a2} = 7.20$, $pK_{a3} = 12.40$
   D. Formic acid, $pK_a = 3.75$

3. Which of the following statements regarding buffers is **TRUE**?
   A. Buffers accept H^+ ions from the solution when H^+ ions are in excess in the solution.
   B. Buffers are not present in cell cytoplasm.
   C. Buffers are a mixture of a strong acid and its conjugate base.
   D. Buffers donate H^+ ions to the solution when OH^- ions are found depleted in solution.

4. Northern blotting is a method used to locate a sequence of:
   A. RNA
   B. DNA
   C. protein
   D. lipid

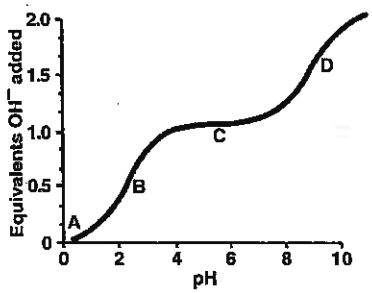
5. The following amino acid is able to form a disulfide bond:
   A. Cysteine
   B. Methionine
   C. Arginine
   D. Threonine

6. Lectins are _____.
   A. proteins that promote cell-cell interaction.
   B. proteins only found in animals.
   C. proteins that aid in selection of proteins bound for the Golgi complex.
   D. proteins containing sugar residues.

7. Which of the following definition is **NOT** properly matched with the respective proteins?
   A. Collagen: Structural protein
   B. Keratin: Transport/storage protein
   C. Antibody: Immune system molecule
   D. Myoglobin: Transport protein

Continued...

8. The letters A through D designate certain regions on the titration curve for glycine (shown below). Which one of the following statements concerning this curve is **TRUE**?



A. Point A represents the region where glycine is deprotonated.
B. Point B represents a region of minimal buffering.
C. Point C represents the region where the net charge on glycine is zero.
D. Point D represents the pK of glycine's carboxyl group.

9. Which one of the following statements about DNA structure is **FALSE**?
A. The DNA base is written in the 3' to 5' direction.
B. The repeating DNA linkage is a 3',5'-phosphodiester bond.
C. The DNA chain has 5' end, which is normally attached to a phosphate group, and a 3' end, which is usually a free hydroxyl group.
D. The DNA chain is present as antiparallel double stranded form.

10. Which one of the following statements about protein structure is **TRUE**?
A. The formation of a disulfide bond in a protein requires the two cysteine residues be adjacent to each other in the primary sequence of the protein.
B. The stability of quaternary structure in proteins is mainly a result of covalent bonds among the subunits.
C. The denaturation of proteins always leads to irreversible loss of secondary and tertiary structure.
D. The information required for the correct folding of a protein is contained in the specific sequence of amino acids along the polypeptide chain.

11. Which one of the following statements about fatty acid is **FALSE**?
A. Properties of fatty acids are dependent on chain length and the degree of saturation.
B. Unsaturated fatty acids have lower melting points than saturated fatty acids of the same length.
C. Long chain length and saturation enhance the fluidity of fatty acids and of their derivatives.
D. Melting temperature of palmitic acid (C_{16}) is lower than that of stearic acid (C_{18}).

12. The competitive inhibitor molecule_____.
A. often has a conformation that does not resemble that of the enzyme substrate.
B. competes directly with the substrate for the enzyme active site.
C. increases the substrate binding to the active site.
D. changes the structure of the active site.

Continued...

13. Choose the correct definition for the bioinformatics terms below.
    A. Identity – the extent to which two (nucleotide or amino acid) sequences are related.
    B. Gap – A space introduced into an alignment or a position at which a letter is paired with a null.
    C. Similarity – The extent to which a nucleotide or a protein sequence are invariant.
    D. Juxtaposition – The presence of a non-identical amino acid at a given position in an alignment.

14. Which of the following statements about enzymes is **FALSE**?
    A. Enzyme alters the reaction rate, but not the reaction equilibrium.
    B. Enzymes accelerate reactions by reducing activation energy.
    C. The interaction of the enzyme & substrate at the active site prohibits the formation of the transition state molecule.
    D. Many enzymes require cofactors for activity.

15. Which one of the following statements about vitamins is **FALSE**?
    A. Vitamins are organic nutrients required in small quantities for a variety of biochemical functions.
    B. Nutrients that our body does not make on its own.
    C. They are essential for providing good health and are necessary for many life functions.
    D. They contain calories and impart energy directly.

16. Which of the following statement(s) about carbohydrates is/are **FALSE**?
    i. Lectin is a glycoprotein.
    ii. Glycogen is a linear polysaccharide.
    iii. Most of the naturally occurring sugars are L-isomers.
    iv. It is possible that carbohydrates contain same chemical formula but different structures.

    A. i and ii
    B. i, ii and iii
    C. i and iii
    D. iii and iv

17. The 3D structure of a protein can be determined by _____.
    i. SDS-PAGE gel electrophoresis
    ii. Mass spectrometry
    iii. Nuclear magnetic resonance spectroscopy
    iv. X-ray crystallography

    A. i and ii
    B. ii and iii
    C. iii and iv
    D. ii, iii and iv

Continued...

18. Proteins can be purified based on the differences in _____.
    i. Affinity
    ii. Size
    iii. Solubility
    iv. Charge

    A. i and iii
    B. i, ii and iii
    C. i, ii, iii and iv
    D. ii, iii and iv

19. Which of the following statement(s) about protein structure is/are **TRUE**?
    i. Antiparallel sheet is more stable than parallel sheet because of the side chain stabilization.
    ii. All amino acids are present in similar proportion in different secondary structures.
    iii. The α-helix is stabilized by intrachain hydrogen bonds between amino and carboxyl groups of amino acids near to each other in the linear sequence.
    iv. The *trans* form of peptide bond is preferred because the formation is more energetically favorable than the *cis* form.

    A. i and iii
    B. ii and iv
    C. ii, iii and iv
    D. iii and iv

20. Which of the following statements about noncovalent interactions is/are **FALSE**?
    i. Ionic bonds are the result of electrostatic attraction between two ionized functional groups of opposite charge.
    ii. Hydrogen bonds result from interaction of an anion with a hydrogen atom.
    iii. Hydrophobic interactions are electrostatic attractions between nonpolar functional groups and water.
    iv. H^+ and OH^- interact together by ionic bonding to form water.

    A. i and ii
    B. ii and iii
    C. i, ii and iii
    D. ii, iii and iv

Continued...

MULTIPLE CHOICE QUESTION ANSWER SHEET

TABLE NO:_____ STUDENT ID:_____

SUBJECT: _____ SUBJECT CODE:_____

1. (A)(B)(C)(D)	2. (A)(B)(C)(D)	3. (A)(B)(C)(D)	4. (A)(B)(C)(D)
5. (A)(B)(C)(D)	6. (A)(B)(C)(D)	7. (A)(B)(C)(D)	8. (A)(B)(C)(D)
9. (A)(B)(C)(D)	10. (A)(B)(C)(D)	11. (A)(B)(C)(D)	12. (A)(B)(C)(D)
13. (A)(B)(C)(D)	14. (A)(B)(C)(D)	15. (A)(B)(C)(D)	16. (A)(B)(C)(D)
17. (A)(B)(C)(D)	18. (A)(B)(C)(D)	19. (A)(B)(C)(D)	20. (A)(B)(C)(D)

PART B: SHORT ANSWER TYPE (SAT) QUESTIONS

Answer Any FIVE questions [50 marks]

Question 1

A. DNA with a high content of G-C base pairs has a higher melting temperature than DNA with a high content of A-T base pairs. Explain why. [2 marks]

B. List four components that are required for DNA replication. [2 marks]

C. What is an advantage of codon degeneracy? [2 marks]

D. What chemical forces are involved in stabilization of DNA double helix? [2 marks]

E. Write the sequence of the mRNA molecule synthesized from a DNA template strand having the following sequence.

5'- ATCGTACCGTTA - 3' [2 marks]

Continued...

Question 2

A. What are the purposes of using sodium dodecyl sulfate and β-mercaptoethanol for protein preparation in SDS-PAGE gel electrophoresis? [3 marks]

B. When a protein is unfolded (denatured), it becomes less water soluble and often precipitates from aqueous solution. Explain. [2 marks]

C. What are three major classes of proteins based on their water solubility? Describe briefly their protein physical properties. [3 marks]

D. Name two chromatography methods for the separation of biomolecules. [2 marks]

Question 3

A. What are three main principles in evolution process? [3 marks]

B. Why is water a polar molecule? [2 marks]

C. What is the pH of an acetic acid solution that contains 70% acetate form and 30% acetic acid undissociated form given that the K_a is 1.74×10^{-5}? Show the calculation steps. [2 marks]

D. According to RNA world hypothesis, RNA molecules were precursors to all current life on earth. What were the roles of RNA in evolution of cellular life? Why are DNA and proteins slowly takes over these roles? [3 marks]

Question 4

A. What are the 2 factors that determine the ability of a molecule to cross a membrane? [2 marks]

B. What are the 2 types of ATP driven pumps? [2 marks]

C. Explain the function of the following domains of a calcium^{2+} ATPase.
i. P domain
ii. N domain
iii. A domain
iv. transmembrane domain. [4 marks]

D. Explain the functions of gap junctions. [2 marks]

Continued...

Question 5

A. List three reasons why carbohydrates are considered important molecules. [3 marks]

B. Why is there excessive branching in glycogen? [2 marks]

C. How is disaccharide form? [2 marks]

D. What is a glycoprotein? [1 mark]

E. What is the main difference between the synthesis of DNA and synthesis of polysaccharides? [2 marks]

Question 6

A. The enzyme D-amino acid oxidase has a very high turnover number because the D-amino acids are potentially toxic. The K_m for the enzyme is in the range of 1 to 2 mM for the aromatic amino acids and in the range of 15 to 20 mM for amino acids such as serine, alanine and the acidic amino acids. Which of these amino acids are the preferred substrates for the enzyme? Explain your answer briefly. [2 marks]

B. Amino acids that are far apart in the amino acid sequence of an enzyme can be essential for its catalytic activity. What does this suggest about its active site? [2 marks]

C. What information can you obtain about enzyme from K_m and V_{max} values? [2 marks]

D. What are the two models describing the enzyme-substrate binding? [2 marks]

E. How is the enzyme activity regulated? Name two mechanisms. [2 marks]

End of paper